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**United States Patent** [19][11] **Patent Number:** **5,317,647****Pagallo**[45] **Date of Patent:** **May 31, 1994****[54] CONSTRAINED ATTRIBUTE GRAMMARS  
FOR SYNTACTIC PATTERN RECOGNITION**[75] **Inventor:** Giulia Pagallo, Cupertino, Calif.[73] **Assignee:** Apple Computer, Inc., Cupertino, Calif.[21] **Appl. No.:** 864,607[22] **Filed:** Apr. 7, 1992[51] **Int. Cl.<sup>5</sup>** ..... G06K 9/62[52] **U.S. Cl.** ..... 382/14; 382/9;  
382/30; 395/12; 395/63[58] **Field of Search** ..... 382/14, 15, 9, 30, 10,  
382/34; 395/12, 63, 21**[56] References Cited****U.S. PATENT DOCUMENTS**

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**[57] ABSTRACT**

A method for defining and identifying valid patterns for used in a pattern recognition system. The method is particularly well suited for defining and recognizing patterns comprised of subpatterns which have multi-dimensional relationships. The definition portion is embodied in a constrained attribute grammar. The constrained attribute grammar includes nonterminal, keyword and non-keyword symbols, attribute definitions corresponding to each symbol, a set of production rules, and a relevance measure for each of the key symbols. Each of the symbols represents a subpattern. The production rules includes syntactic, semantic, constraints and action portions. It is the production rules which define the dimensional relationships between the various subpatterns. An instantiation of a constrained attribute grammar is called a language. The verification portion is comprised of a parsing scheme that determines validity of a pattern. The verification portion receives a set of input subpatterns provided by a character recognition system and a provided language. When a valid pattern is recognized, a representation of the pattern in a form suitable for use by a data manipulation means is provided as output.

**4 Claims, 8 Drawing Sheets**